tion of the iodoform test, had already discovered the presence of a volatile substance in human urine, as well as in that of various animals, which gives the iodoform test. Working on larger quantities of urine, he has arrived at the conclusion that this substance is not alcohol. M. Lieben also has failed to isolate and identify the substance, owing to the very small quantity present in the urine ; he thinks, however, that it may be one of the odoriferous constituents of the urine. According to the author's experience this cannot, however, be the case, since, first, the quantity of substance yielding the iodoform does not seem to be diminished by distillation over animal charcoal, whereas the urinous odour is thus almost entirely removed ; secondly, the urinous odour of the distillate, in case no animal charcoal was used, is not destroyed by heating with the bichromate solution, which nevertheless produces acetic acid ; thirdly, a somewhat similar substance seems present in the breath. It might be, however, that the substance giving the iodoform test and that yielding the acetic acid are two different compounds ; this must be left to future researches to decide.

In conclusion, it may not be uninteresting to point out that the quantity of substance which yields the acetic acid apparently falls below the normal proportion just after the effect of a dose or doses of alcohol has passed off ; after which it gradually rises again to the normal standard. A somewhat analogous effect was observed by Dr. Bence Jones and the author, in their research on the passage of quinine into and out of the tissues &c., to follow the administration of quinine. In this case the natural fluorescence of the extracts from the tissues, due to the presence of a substance resembling quinine, and therefore called animal quinoidine by the discoverers, frequently fell below the normal standard just after the effect of the quinine had passed off, gradually rising again to the normal proportion. A closer study of this relation might perhaps throw considerable light on the physiological action of alcohol both in health and in disease.

April 11, 1872.

The EARL OF ROSSE, D.C.L., Vice-President, in the Chair.

The following Letter was read :—

Whitehall, 23rd February, 1872.

SIR,—I have had the honour to lay before the Queen the loyal and dutiful Address of the President, Council, and Fellows of the Royal Society on the occasion of the illness of His Royal Highness the Prince of Wales.

I have to inform you that Her Majesty was pleased to receive the Address very graciously. I am, Sir, your obedient Servant,

(Signed) H. A. BRUCE.

W. Sharpey, Esq., M.D., Secretary to the Royal Society,
Burlington House, W.

The following communications were read :—

I. " Contributions to the History of the Opium Alkaloids."— Part V. By C. R. A. WRIGHT, D.Sc., Lecturer on Chemistry in St. Mary's Hospital Medical School. Communicated by Prof. G. G. STOKES, Sec. R. S. Received March 9, 1872.

§ 1. *On the Polymerides of Codeia.*

In Part IV. of these researches reasons have been adduced for the following general conclusions, viz. that codeia and morphia are capable of forming polymerides (with the elimination of methyl in the case of codeia in some instances), which yield derivatives containing certainly not less than C_{68}, and probably not less than C_{136} (C_{72} and C_{144} in the case of those codeia derivatives where methyl has not been eliminated). Experiments now in progress tend to show that the formulæ of codeia and morphia are really double of those formerly ascribed to these bases, *i. e.* are $C_{36} H_{42} N_2 O_6$ and $C_{34} H_{38} N_2 O_6$ respectively, the proof of which is (as will be shown in a subsequent communication) that the first products of the action of hydrochloric acid on these bases appear to contain chlorine and carbon in the proportions C_{36} and Cl, C_{34} and Cl respectively, instead of C_{18} and Cl, C_{17} and Cl. It might be anticipated, therefore, that intermediate polymerides might be formed containing respectively :—

Morphia series.		Codeia series.	
Monomorphia..	$C_{34} H_{38} N_2 O_6$	$C_{36} H_{42} N_2 O_6$	.. Monocodeia.
Dimorphia	$C_{68} H_{76} N_4 O_{12}$	$C_{72} H_{84} N_4 O_{12}$	.. Dicodeia.
Trimorphia....	$C_{102} H_{104} N_6 O_{18}$	$C_{108} H_{126} N_6 O_{18}$	.. Tricodeia.
Tetramorphia..	$C_{136} H_{152} N_8 O_{24}$	$C_{144} H_{168} N_8 O_{24}$	.. Tetracodeia.

In the case of codeia these anticipations have been verified.

In order to obtain these supposed polymerides before their further alteration by secondary reactions, the action of acids other than the hydracids was examined. Acetic acid seemed a probable agent for this purpose ; but no appreciable quantity of any thing different from ordinary codeia was obtained after sixty-four hours' digestion at 100° of one part of this base with three parts of glacial acetic acid. On precipitation of the product by $Na_2 CO_3$ in large excess, extraction with ether, and agitation of the ethereal extract with H Cl, a crystalline mass was obtained which developed a smell of acetic acid on standing in contact with a slight excess of H Cl ; but on analysis this gave numbers agreeing with those required for codeia hydrochlorate, and from it nothing different from codeia could be obtained ; probably therefore only a trace of acetyl-codeia was formed.

The action of phosphoric acid, however, was found to lead to the desired result without the formation of bye-products beyond colouring-matters formed by the high temperature employed ; by heating codeia with 3 parts of glacial phosphoric acid and 5 of water for several hours at 100°, no per-

ceptible change is produced.   The same result follows on boiling for twelve hours (boiling-point 105°) with an inverted condenser attached to prevent loss of water by evaporation; but if the boiling-point be allowed to rise slowly from evaporation, the mixture being very gently boiled in a long-necked flask, the product gradually acquires the power of giving an immediate amorphous precipitate with $Na_2 CO_3$; no large amount of new substances are, however, formed until the boiling-point has risen to about 200°, beyond which point the evaporation cannot safely be pushed.   The viscid chestnut-coloured liquid, while still hot, is dissolved in boiling water and allowed to cool; nothing separates on cooling: when cold, the liquid is nearly neutralized by caustic soda, and then precipitated with $Na_2 CO_3$; the precipitate is collected on filters, drained from mother-liquors, dissolved in weak $H Cl$, and reprecipitated by $Na_2 CO_3$, to get rid of traces of unaltered codeia mechanically retained; finally, the drained precipitate is exhausted with ether.   The ethereal solution yields on agitation with $H Cl$ a crystalline hydrochlorate, which may be purified by solution in water, fractional precipitation with $Na_2 CO_3$, and repetition of the ether process, and finally by recrystallization of the resulting hydrochlorate.

The portion of the first $Na_2 CO_3$ precipitate insoluble in ether is dissolved in $H Cl$, and fractionally precipitated by $Na_2 CO_3$, to remove colouring-matters as much as possible : the last precipitate, after thorough washing and drying, forms a light buff-coloured amorphous powder that does not soften at 100° when perfectly dry, but clots to a resinous mass if heated in the water-bath while still moist; it is soluble in alcohol, is precipitated from this solution on addition of ether, and yields salts that have no vestige of crystalline characters.

Both the crystalline and the non-crystalline hydrochlorates yield on analysis numbers identical with those required for codeia hydrochlorate; for the reasons developed in the subsequent sections, they are regarded as respectively di- and tetracodeia.

The filtrate from the original $Na_2 CO_3$ precipitate contains much unaltered codeia; by extracting with ether and agitation of the extract with excess of phosphoric-acid solution, a mixture of phosphates is obtained, from which a further quantity of each polymeride is obtainable by simply boiling down the liquid till the boiling-point reaches 200°.

The hydrochlorate of tetracodeia obtained as above described forms a brownish brittle tar, not fusible at 100° when dry; dried at 100° it yields the following numbers :—

Specimen A. 0·325 grm. gave 0·773 CO_2 and 0·186 $H_2 O$.
    „   B. 0·3145   „   „   0·732   „   0·185   „
              0·1215   „   „   0·0495 Ag Cl.

	Calculated.		Found.	
			A.	B.
C_{144}	1728	64·38	64·87	63·48
H_{176}	176	6·56	6·36	6·54
N_8	112	4·17		
O_{24}	384	14·30		
Cl_8	284	10·59		10·08
$C_{144} H_{168} N_8 O_{24}, 8H\,Cl$	2684	100·00		

The free base gave the following numbers :—

0·3095 grm. gave 0·818 CO_2 and 0·190 H_2O.

	Calculated.		Found.
C_{144}	1728	72·24	72·08
H_{168}	168	7·02	6·82
N_8	112	4·68	
O_{24}	384	16·06	
$C_{144} H_{168} N_8 O_{24}$	2392	100·00	

In appearance and most physical properties, tetracodeia and its salts bear a great resemblance to chloro- and bromo-tetracodeia; and they further agree in that all yield a blood-red colour on warming with silver nitrate and nitric acid, or with nitric acid alone ; it differs from chloro-tetracodeia in that the aqueous solution of the hydrochlorate does not precipitate on the addition of strong H Cl, the salt being apparently as soluble in diluted H Cl as in water ; also the free base does not oxidize so readily.   In all respects tetracodeia agrees with the description given by Anderson of his "amorphous codeia" [*] obtained by the action of sulphuric acid on codeia. On comparison with the product obtained by Anderson's process, no essential differences could be detected between the two substances, except that the phosphoric-acid product was somewhat darker in tint, owing no doubt to the presence of colouring-matters from the higher temperature employed in its production.

The hydrochlorate of dicodeia obtained as above described crystallizes with $3H_2O$ for every C_{18} contained, this water of crystallization being wholly lost at 100° and partially by standing over sulphuric acid.

2·163 grms. of crystals dried on filter-paper lost at 100° 0·295 grm.
Actual loss .... = 13·63 per cent.
Calculated for........ $C_{72} H_{84} N_4 O_{12}, 4H\!Cl + 12H_2O$ = 13·86   ,,
2·012 grms. of crystals that had stood three days $\Big\}$ = 8·54   ,,
   over $SO_4 H_2$ lost, at 100°, 0·172........... $\Big/$

* Anderson, Ed. Phil. Trans. xx. [1] 57.

Dried at 100°, these crystals gave these numbers :—

0.306 grm. gave 0.719 CO_2 and 0.182 H_2O.
0.3135 ,, 0.742 ,, 0.194 ,,
0.229 ,, 0.098 $AgCl$.

	Calculated.		Found.	
C_{72}	864	64·38	64·08	64·54
H_{83}	88	6·56	6·61	6·88
N_4.	56	4·17		
O_{12}	192	14·30		
Cl_4	142	10·59	10·60	
$C_{72}H_{84}N_4O_{12}$, 4HCl	1342	100·00		

Na_2CO_3 throws down from the solution of the hydrochlorate white amorphous flakes that do not oxidize spontaneously in the air.   Dried at 100°,

0.2965 grm. gave 0.7765 CO_2 and 0.189 H_2O.

	Calculated.		Found.
C_{72}	864	72·24	71·43
H_{84}.	84	7·02	7·08
N_4	56	4·68	
O_{12}	192	16·06	
$C_{72}H_{84}N_4O_{12}$	1196	100·00	

If the solution of the hydrochlorate be concentrated, the addition of Na_2CO_3 solution throws down tarry globules consisting of a mixture of the base and its hydrochlorate, the salt being sparingly soluble in the NaCl solution formed by the decomposition.

Dicodeia and its salts do not yield a blood-red colour with NO_3H, only a slight orange tint; Fe_2Cl_6, also $SO_4H_2 + K_2Cr_2O_7$, give no colour-reactions.

In general properties, and in the fact that the water of crystallization possessed by the hydrochlorate is lost at 100°, dicodeia bears a great resemblance to the "isomer of codeia" obtained by Drs. Matthiessen and Armstrong by the action of diluted sulphuric acid on codeia[*].   On comparison with the product obtained by Armstrong's process, no difference whatever was discernible provided the hydrochlorate obtained by the action of sulphuric acid &c. were several times recrystallized.   The crude hydrochlorate contains, besides the dicodeia salt, the hydrochlorate of another polymeride which differs from dicodeia hydrochlorate in that it is non-crystalline, drying up to a gummy, extremely hygroscopic and deliquescent substance; it yields a blood-red colour with NO_3H, and with $SO_4H_2 + K_2$ Cr_2O_7 a very evanescent purplish red; Fe_2Cl_6 gives no coloration at first,

* Chem. Soc. Journ. [2] ix. 56.

but on standing, a reddish purple tinge appears, gradually becoming more intense. $Na_2 CO_3$ throws down an amorphous white precipitate, which is soluble in ether and but little changed by exposure to air.   From these properties, which seem to be analogous in some respects to dicodeia, in others to tetracodeia, the base is considered to be intermediate between these two polymerides, *i. e.* to be *tricodeia*.   The crude hydrochlorate of dicodeia obtained by Armstrong's process furnished on recrystallization mother-liquors which, on standing over $SO_4 H_2$ for several weeks, gradually deposited crystals, and finally became a crystalline mass wetted with a viscid non-crystalline liquid : by gentle pressure in filter-paper the liquid portion was separated from the crystals, which were found to be only dicodeia hydrochlorate ; and finally the treacly hydrochlorate of tricodeia was extracted from the papers by water.   On repetition of the treatment over $SO_4 H_2$, no crystals were obtained even after several weeks' standing ; at 100° a brittle, gummy, hygroscopic substance was obtained, of which

0·309 grm. gave 0·730 CO_2 and 0·191 H_2O.
0·208   ,,   0·0895 AgI.

	Calculated.		Found.
C_{108}	1296	64·38	64·43
H_{132}	132	6·56	6·87
N_6...................	84	4·17	
O_{18}	288	14·30	
Cl_6	213	10·59	10·64
$C_{108} H_{126} N_6 O_{18}, 6HCl$	2013	100·00	

§ 2.   *Action of Hydrochloric Acid on the Polymerides of Codeia.*

(*a*) *Tetracodeia.*—Tetracodeia hydrochlorate was boiled for six hours with a large excess of strong HCl ; no perceptible evolution of methyl chloride took place ; and on examining the resulting product no change was found in the ratio of carbon to chlorine.   Hence no substitution of Cl for OH had taken place, and apparently no action at all had ensued.

(*b*) *Tricodeia.*—Tricodeia hydrochlorate was heated to 100° for $1\frac{1}{4}$ hour with a large excess of strong HCl ; on adding water to the product, a tarry substance was precipitated, whereas the original tricodeia hydrochlorate is readily soluble in dilute HCl : precipitated by $Na_2 CO_3$ and the precipitate exhausted with ether, a viscid non-crystalline hydrochlorate was obtained on agitation of the ethereal extract with HCl.   The reactions of this product appear to be identical with those of tricodeia, excepting that the reddish purple tinge with $Fe_2 O_6$ appears instantaneously instead of only after standing a short time.   Dried at 100°,

0·3070 grm. gave 0·756 CO_2 and 0·185 H_2O.
0·2480   ,,   0·1150 AgCl.

	Calculated.		Found.
C_{108}	1296	68·03	67·16
H_{120}	120	6·30	6·69
Cl_6	213	11·18	11·48
N_6	84	4·41	
O_{12}	192	10·08	
$C_{108} H_{114} N_6 O_{12}, 6HCl$	1905	100·00	

Hence this product has been formed by the reaction

$$C_{108} H_{126} N_6 O_{18}, 6HCl = 6H_2 O + C_{108} H_{114} N_6 O_{12}, 6HCl,$$
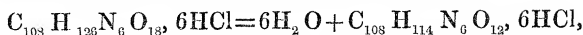
and has the composition of a polymeride of " apocodeia." From the great similarity observed between this product and " apocodeia " made by Matthiessen and Burnside's process*, it appears probable that the product of the action of zinc chloride on codeia is a mixture of bodies of general formula $(C_{18} N_{10} NO_2)_n$, $nHCl$, in which the derivative where $n=6$ greatly predominates : experiments on the action of zinc chloride on morphia now in progress in conjunction with Herr L. Mayer indicate that mixtures are obtained in this case also.

(c) *Dicodeia.*—When pure dicodeia hydrochlorate is heated to 100° for one hour with a large excess of HCl, a change is produced expressible by the equation

$$C_{72} H_{84} N_4 O_{12}, 4HCl + HCl = C_{72} H_{83} Cl N_4 O_{11}, 4HCl + H_2 O,$$
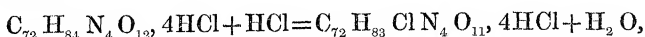
which shows that the formula of this polymeride contains at least C_{72}. $Na_2 CO_3$ throws down from the product a voluminous white precipitate, which differs in appearance slightly from that of dicodeia and turns green by exposure to air ; ether dissolves this precipitate, and on agitation with HCl a viscid hydrochlorate is obtained which does not crystallize, but dries up to a gum. $Fe_2 Cl_6$ gives a brown-purple tint, $NO_3 H$ a blood-red, and $K_2 Cr_2 O_7 + SO_4 H_2$ a lighter blood-red, none of which reactions occur with the original dicodeia. Dried at 100°,

0·3200 grm. gave 0·737 CO_2 and 0·189 $H_2 O$.
0·3260   ,,   0·172 AgCl.

|	Calculated.		Found.
C_{72}	864	63·50	62·82
H_{87}	87	6·39	6·56
Cl_5	177·5	13·04	13·06
N_4	56	4·12	
O_{11}	176	12·95	
$C_{72} H_{83} Cl N_4 O_{11}, 4HCl$	1360·5	100·00	

* Proc. Roy. Soc. vol. xix. p. 71.

§ 3. *Action of Hydriodic Acid and Phosphorus on the Polymerides of Codeia.*

(*a*) *Dicodeia.*—When pure dicodeia is dissolved in a large excess of strong hydriodic acid (55 per cent. HI) and heated, together with a piece of phosphorus, to ebullition until the boiling-point rises to 120°, methyl iodide is given off and a considerable quantity of phosphoric acid formed. The product, filtered through asbestos and precipitated with water, yields snow-white flakes that become yellow by exposure to air, and melt to a colourless oil at 100° when moist, although they do not fuse at that temperature when thoroughly dried.   Dried at 100°,

$$0 \cdot 3155 \text{ grm. gave } 0 \cdot 5620 \ CO_2 \text{ and } 0 \cdot 1460 \ H_2O.$$
$$0 \cdot 1895 \qquad ,, \qquad 0 \cdot 1190 \ AgI.$$

	Calculated.		Found.
C_{136}	1632	48·45	48·58
H_{161}	161	4·78	5·14
I_9	1143	33·94	33·92
N_8	112	3·33	
O_{20}	320	9·50	
$C_{136} H_{153} I N_8 O_{20}, 8HI$	3368	100·00	

Hence this substance is formed by the reaction

$$2C_{72}H_{81}N_4O_{12}, 4HI + 17HI = I_8 + 4H_2O + 8CH_3I + C_{136}H_{153}IN_8O_{20}, 8HI.$$
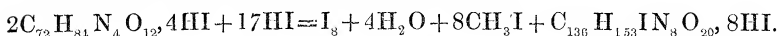
The physical properties of this substance are almost identical with those of the bodies of analogous constitution (containing C_{136}) formerly obtained from both codeia and morphia (Part IV.). Carbonate of sodium throws down a precipitate almost insoluble in ether, showing that polymerization to the tetra series has taken place ; agitated with a large bulk of ether, this precipitate furnishes an extract which, on agitation with dilute nitric acid and boiling with $AgNO_3$ and NO_3H of the nitrate thus obtained, yields a precipitate of AgI, showing that iodine is contained in the precipitated base. The substance itself, boiled with $AgNO_3$ and HNO_3, produces a deep orange-colour, intermediate in tint between the blood-red produced by the derivatives of polymerized $C_{17}H_{19}NO_3$, and the deep yellow of those of polymerized $C_{17}H_{21}NO_3$, a result confirmatory to some extent of the formula deduced from the analysis, this being capable of representation as

$$8(C_{17}H_{20}NO_3) + 9HI - 4H_2O.$$
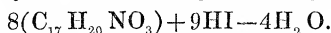
From this it appears pretty evident that the formulæ hitherto attributed to the tetra bases (containing $C_{68} - C_{72}$) are only half the true ones, which contain $C_{136} - C_{144}$.

(*b*) *Tetracodeia.*—On treating tetracodeia in the same way and continuing the ebullition until the temperature reaches 130°, a brown syrupy liquid is finally obtained, which yields, on filtration through asbestos and

precipitation with water, a yellow brittle tar not fusible at 100° when quite dry ; methyl iodide is produced in quantity during the action, but only traces of phosphoric acid, and this probably by atmospheric oxidation. Dried at 100° the tar gave these numbers :—

0.3660 grm. gave 0.621 CO_2 and 0.149 H_2O.
0.5520 ,, 0.363 AgI.

	Calculated.		Found.
C_{136}	1632	46·31	46·27
H_{158}	158	4·48	4·53
I_{10}	1270	36·04	35·54
N_8	112	3·18	
O_{22}	352	9·99	
$C_{136}H_{150}I_2N_8O_{22},8HI$	3524	100·00	

Hence this substance is formed by the reaction

$$C_{144}H_{168}N_8O_{24}, 8HI + 10HI = 8CH_3I + 2H_2O + C_{136}H_{150}I_2N_8O_{22}, 8HI.$$
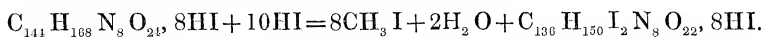
NO_3H and $AgNO_3$ give a blood-red coloration with this product, showing, as the analytical numbers indicate, that it is derived from polymerized $C_{17}H_{19}NO_3$, and not from polymerized $C_{17}H_{20}NO_3$, or $C_{17}H_{21}NO_3$.

The foregoing results show that the methyl group in codeia is unaltered during the polymerization to dicodeia and to tetracodeia, and furnishes another proof of the conclusion come to in Part IV. § 2, that the addition of H_2 for C_{17}, when HI and P act on morphia or codeia, takes place *before* and not after the final polymerization ; even polymerization to dicodeia could not precede this addition of H_2, as the product obtained from that polymeride has only H added on for C_{17}.

The following formulæ show clearly the difference in the action of hydriodic acid and phosphorus on codeia and its polymerides :—

Alkaloid.	Temperature.	Formula of product.
Codeia	.... 100°	$8(C_{17}H_{19}NO_3 + H_2) + 12HI.$
,,	.... 110°–115°	$8(C_{17}H_{19}NO_3 + H_2) + 12HI - 4H_2O.$
,,	.... up to 130°	$8(C_{17}H_{19}NO_3 + H_2 - O) + 12HI - 4H_2O.$
Dicodeia	.... up to 120°	$8(C_{17}H_{19}NO_3 + H) + 9HI - 4H_2O.$
Tetracodeia	.. up to 130°	$8(C_{17}H_{19}NO_3) + 10HI - 2H_2O.$

From which it is clear that dicodeia is intermediate between tetracodeia and ordinary codeia. From the fact that the basic 4HI for $8(C_{17})$ are added on in the case of the first product *before* the elimination of $4H_2O$, as in the second substance in the list, it may be inferred that the action is not a true substitution of iodine for hydroxyl; analogous facts have been observed in the chlorinated substances obtained by the action of HCl on codeia and morphia, the first action being apparently a direct *addition* of the elements of HCl, the subtraction of the elements of H_2O taking place at a later stage.

§ 4. *Action of Sulphuric Acid on Codeia and its Polymerides.*

The results detailed in the previous sections show that the action of sulphuric acid on codeia is to polymerize it with the formation of di-, tri-, and tetracodeia, the substances obtained by Armstrong and by Anderson by this means being identical with the first and last of these bases. It appears probable that tetracodeia may be formed by the further polymerization of dicodeia, whereas it would seem as though tricodeia were not likely to be obtained from dicodeia ; on the other hand, it is possible that tetracodeia is directly produced from codeia, and that it could not be formed from dicodeia.   To settle this point, pure dicodeia was heated to very gentle ebullition with sulphuric acid diluted with its own bulk of water for five hours, the operation being conducted in a long-necked flask, so that no appreciable concentration by evaporation took place. At the end of this time the dicodeia was wholly converted into a base, of which ether dissolved only traces, and hence no tricodeia was formed. After precipitation by $Na_2 CO_3$ and drying, the free base was dissolved in alcohol and fractionally precipitated by ether.   If the alcoholic solution be nearly free from water, the ether throws down solid amorphous flakes ; but if 10 or more per cent. of water be present, the ether precipitate is a tarry fluid containing water, alcohol, and the base.   Flakes of tetracodeia were thus obtained identical in all respects with that obtained by the action of phosphoric acid ; a trace of some product of the further action of sulphuric acid appeared to be present, however, as the free base turned slightly green on drying, without, however, absorbing so much oxygen as to make any appreciable difference in its composition.   Dried at 100°, 0·221 grm. gave 0·583 CO_2 and 0·142 H_2O.

	Calculated.		Found.
C_{144}	1728	72·24	71·94
H_{168}	168	7·02	7·14
N_8	112	4·68	
O_{24}	384	16·06	
$C_{144} H_{168} N_8 O_{24}$	2392	100·00	

If the action of sulphuric acid be pushed further than this point, a smell of SO_2 is perceptible, and the product obtained rapidly oxidizes on precipitation by $Na_2 CO_3$ and exposure to air.   Nothing fit for analysis was obtained from the product, which probably is formed by the dehydration, oxidation, and possibly demethylization of tetracodeia.

§ 5. *On the Physiological Action of the foregoing Polymerides.   By* REGINALD STOCKER, *M.B., Pathologist in St. Mary's Hospital Medical School.*

An aqueous solution of the hydrochlorate of codeia and its polymerides was in each case employed, being subcutaneously injected into adult cats (a

dog being also employed in a few experiments), quantities equivalent to $0 \cdot 1$ grm. of the anhydrous salt being used in each experiment.	Four cats were employed, several trials being made with each animal, and three or four days being allowed to intervene between each experiment, so that the effects of one dose had entirely passed away and the animal entirely recovered before the administration of another dose.	The main results observed were as follow :—

Codeia.—Four experiments.	In each instance dilated pupils ; cerebral congestion (determined by ophthalmoscopic examination), and much increased reflex excitability (epileptic convulsions in one case) ; salivation and purging in two cases ; vomiting not produced in any case.

Dicodeia.—Two experiments. In each instance vomiting ; fundus of eye not congested ; pupil dilated in one case.

Another experiment with a dog (full-grown she-terrier) produced salivation and purging without vomiting ; no cerebral congestion.

Tricodeia.—Three experiments.	In each case salivation (profuse) and dilated pupils ; no cerebral congestion ; in one case slight excitement, in the others purging and depression : vomiting produced in one of these two latter instances, micturation in the other.

Tetracodeia.—Four experiments.	In each case profuse salivation, micturation, and depression ; dilated pupils in three instances, and lachrymation in two ; in one case vomiting and purging, in another increased reflex excitability with an occasional convulsion (cat was weak and not in good condition) ; slight hypnotism in two cases.

In two experiments with the dog, salivation and depression only were produced.

From these results it would appear that codeia produces cerebral congestion and increased reflex excitability without vomiting ; whilst di- and tetracodeia produce profuse salivation and some depression, with vomiting in several instances, no evidence of cerebral congestion and but little of increased reflex excitability being noticeable.

§ 6. *Conclusions.*

The foregoing results suggest the probability of other bases being capable of forming similar polymerides.	In anticipation of this result experiments are in progress with morphia.

Hesse has shown[*] that by the action of HCl on thebaine there are produced two isomerides of that base, one forming crystalline salts, one amorphous salts ; not improbably these are respectively dithebaine and tetrathebaine.

Matthiessen and Foster have shown[†] that cotarnine occurs in crystals of the formulæ $C_{12} H_{13} NO_3 + \frac{1}{2} H_2 O$ and $C_{12} H_{13} NO_3 + H_2 O$; and the

[*] Ann. Chem. Pharm. vol. clxiii. p. 47.
[†] Proc. Roy. Soc. vol. xvii. p. 342 (5).

Reagent &c.	Codeia.	Dicodeia.	Tricodeia.	Tetracodeia.
Alcohol	Soluble	Soluble	Soluble	Soluble.
Ether	Soluble	Soluble	Soluble	Insoluble.
Character of base.	Crystalline, stable in the air.	Amorphous, stable in the air.	Amorphous. Very slowly oxidizes while moist.	Amorphous. Very slowly oxidizes while moist.
Character of hydrochlorate.	Crystallizes with $2H_2O$ for C_{18}, not lost at $100°$.	Crystallizes with $3H_2O$ for C_{18}; lost at $100°$, and partially at lower temperatures.	Non-crystalline, extremely deliquescent.	Non-crystalline, deliquescent.
Ferric chloride ...	Nil	Nil when pure ...	No colour at first, reddish purple on standing.	Reddish-purple colour immediately.
Nitric acid	Light orange	Light orange	Blood-red	Blood-red.
Potassium dichromate and sulphuric acid.	Nil	Nil	Evanescent red ...	Evanescent red.
Sodium carbonate and solution of hydrochlorate.	No immediate precipitate, crystals on standing.	Instantaneous amorphous precipitate but little soluble in excess.	Same as dicodeia.	Same as dicodeia.
Caustic potash and solution of hydrochlorate.	Oily precipitate, if concentrated, becoming crystalline on standing. Not markedly soluble in excess.	Oily precipitate, if concentrated, not becoming crystalline; more dilute solutions give a white amorphous precipitate soluble in large excess.	Same as dicodeia.	Same as dicodeia.
Action of hydrochloric acid, not pushed to extreme.	Product contains Cl for C_{36}; further action contains Cl_2 for C_{36}.	Product contains Cl for C_{72}.	H_2O removed for C_{18}; no basic Cl contained in product.	Nil.
Action of hydriodic acid, in conjunction with phosphorus, not pushed to extreme.	Polymerizes with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{21}NO_3)_3$, H_2 being added on for C_{17} in product.	Polymerizes with elimination of CH_3 for C_{18}, forming bases derived from $(C_{17}H_{20}NO_3)_3$, H being added on for C_{17} in product.	....	CH_3 eliminated for C_{18}; product derived from $(C_{17}H_{19}NO_3)_3$, no H being added on, but simply I substituted for OH.
Action of sulphuric acid, not pushed to extreme.	Polymerizes, forming successively di-, tri-, and tetracodeia.	Polymerizes, forming tetracodeia.	....	Nil. Further action probably dehydrates and oxidizes.
Formula inferred from above properties and reactions.	$C_{36}H_{42}N_2O_6$.	$C_{72}H_{81}N_4O_{12}$....	$C_{108}H_{126}N_6O_{18}$.	$C_{144}H_{168}N_8O_{24}$.
Physiological action of 0.1 grm. of anhydrous hydrochlorate subcutaneously injected into adult cats.	Extreme hypersensitiveness and cerebral congestion, dilatation of pupils; no diarrhœa; no vomiting in any instance.	No hypersensitiveness nor cerebral congestion; dilatation of pupils; vomiting in every instance. With a dog profuse diarrhœa without vomiting.	Hypersensitiveness scarcely marked, vomiting in some instances, in others salivation and defæcation.	No hypersensitiveness; vomiting, salivation, or diarrhœa in every case; great depression. With a dog profuse salivation and depression.

writer's observations indicate that the former substance is more stable than the latter, which rapidly becomes more or less coloured ; not improbably these two forms are polymerides, the first being $C_{21} H_{26} N_2 O_6 + H_2 O$, the second $(C_{12} H_{13} NO_3)_n nH_2 O$. Opianic acid[*], on heating, furnishes an anhydride of formula $C_{40} H_{38} O_{19}$; this tends to show that the formula of this acid is not less than $C_{20} H_{20} O_{10}$; not impossibly, therefore, the formula of narcotine may be double that usually ascribed to it, and the dimethyl-nornarcotine, methylnornarcotine, and nornarcotine of Matthiessen may be derivatives not of ordinary narcotine, but of its polymerides.

The different modifications of the cinchona alkaloids are not impossibly polymerides of one another.

The Table (p. 288) exhibits the principal differences between codeia and the polymerides above described.

II. " Researches on Solar Physics."—III.   By WARREN DE LA RUE, D.C.L., F.R.S., BALFOUR STEWART, LL.D., F.R.S., and BENJAMIN LOEWY, F.R.A.S.   Received March 12, 1872.

(Abstract.)

The authors present in this paper the third instalment of the determination of the areas and heliographic positions occupied by the sun-spots observed by the Kew photoheliograph, comprising the years 1867, 1868, and 1869.   They announce that the fourth and last instalment is in active progress, and will be preceded by the final discussion of the whole ten-yearly period, during which the photoheliograph has been at work. This final discussion will contain the determination of the astronomical elements of the sun on the basis of photographic observations ; and this work, they anticipate, will not only settle the question of rotation for a considerable time to come, but will also throw light upon many points which have only recently been brought under the consideration of scientific men. The results in general, they believe, will prove the superiority of photographic sun-observations over previous methods.   The second question which will be discussed is the distribution of sun-spots over the solar surface. The facts already brought out indicate that the progress of the inquiry may lead to some definite laws which regulate the distribution ; there appear to exist centres of great activity on the sun, and the different solar meridians seem to have various but definite intervals of rest and activity.   In conclusion the authors point out the necessity of devoting in future greater attention to the study of the faculæ, and express a hope of seeing photographic sun-observations carried on in this country on a more extended system, connecting from day to day solar phenomena with terrestrial meteorology and magnetism.

[*] Proc. Roy. Soc. vol. xvii. p. 341, § III. (Matthiessen and Wright).